# Analysis and Control of Power Electronic Elements inserted into Modern Power Transmission Grids

**Key words:** power converters, interaction and coordination, HVDC, inter-area oscillations, small-signal stability

**Context:**
Power electronics is more and more used on the power transmission grids. Indeed, all wind and photovoltaic generation is connected to the grid by converters. Also, the reinforcement of the grid is frequently done with High-Voltage Direct Current (HVDC) lines which consist of 2 power converters into a back-to-back connection and a DC cable. This tendency will be extended in future in order to ensure the transition towards decarbonized energy systems as formulated, for example, in Europe.

This new technology based on power electronics is active in the sense that it provides several degrees of freedom for the power and voltage control. Thus, it has an impact on the dynamics of the neighbour AC power system. In particular, the small-signal and the transient stability depend on the way in which the regulators of the converters are synthesized. This raises several control questions:

- how to improve the transient stability of the neighbour zone?
- how to quantify and diminish the interactions between two close HVDC ?
- how to damp inter-area modes (i.e., low frequency electromechanical oscillations of the power grid) via power-modulation control of the HVDC?

**Research subject, general work plan:**

A new control framework should be proposed in order to take full advantage for robustness and performances. Transient and small-signal stability are envisaged. Specific advanced control methods will be used to answer the specifications. Validations both in simulation and hardware in the loop are envisaged.

**Competences needed :**

The candidate should have background and competence in modelling of power electronics for power systems. An experience on implementation on real material is mandatory. As the approaches will be in the field of automatic control, knowledge of advanced control techniques (like robust H-infinity or H2 control) would be a serious advantage.

**Framework:**
This work is proposed in a general framework of collaboration with RTE – the French Transmission System Operator – and it is thus connected to real needs of the interconnected power systems. Realistic tests and validations of the theoretic developments mentioned above are possible on grid models and scenarios provided by RTE. The Control of Power Grids chair ( http://chairerte.ec-nantes.fr/ ) which exists between Ecole Centrale Nantes and RTE R&D guarantees the direction and the financial founding of this work. The work will be carried out in Nantes-France.

Contact:
B. Marinescu, Ecole Centrale Nanates-IRCCyN, head of the chair Control of Power Grids,
Bogdan.Marinescu@irccyn.ec-nantes.fr, (33)2 40 37 69 46